The third disturbance was due to a low barometer passing over the Lakes on the 17th and 18th. The weather conditions throughout the state were much disturbed as it passed eastward to the Saint Lawrence Valley and produced high winds and copious rainfalls at all stations on those dates. Another low pressure followed the same path five days later and caused precipitation at many places on the 23d. The most destructive storm, however, that occurred during the month came from North Carolina and passed during the afternoon and evening of the 25th across the state through the counties of Cape May, Camden, Cumberland, Burlington, Gloucester, Salem, Atlantic, and Ocean.

The passage of this eastward was followed by a cold wave from the Northwest, and the lowest temperature of the month was recorded throughout the state on the morning of the 27th. The rainfall mostly occurred inside of a limit of ten days and was quite uniformly distributed, the extremes being for the month 3.37 inches at Egg Harbor City and 5.03 at Clayton. The rainfall throughout the state was above the mean as compared with valuable tables of Prof. J. C. Smock. Two cold-wave warnings were received during the month, both of which were fully justified.

The following is an extract from the November, 1886, report of the "Ohio Meteorological Bureau," Prof. B. F. Thomas, of the Ohio State University, Columbus, director:

The mean temperature was lower than that of either of the four preceding Novembers, being 38°.8. The five-year average is 40°.4, and the normal, 41°.6. The highest November maximum, 80°, was reached at Paulding on the 2d. The minimum, 11°, was not as low as usual, but the mean daily range was 1°.1 above the five-year average of 16°.8.

The mean rainfall was the greatest we have reached for November, being 4.23 inches. Our five-year average is 2.8 inches, and the normal for the state 3.26. The greater part of this rainfall occurred on the 6th, 12th, 17th, and 23d, on which dates the principal storms of the month passed over the state.

Summary.

Mean temperature, 38°.8; highest temperature, 80°.0, at Paulding, on the 2d; lowest temperature, 11°.0, at Ohio State University and Paulding, 27th and 16th; range of temperature, 69°.0; mean daily range of temperature, 17°.9; greatest daily range of temperature, 49°.0, at Paulding, on the 21st; least daily range of temperature, 3°.0, at New Alexandria, on the 23d and 30th.

Average number of clear days, 7.6; average number of fair days, 9.5; average number of cloudy days, 12.9; average number of days on which rain fell, 11.3.

Mean monthly rainfall, 4.23 inches; mean daily rainfall, 0.14 inch: greatest number of days on which rain fell, 16, at Levering and Hiram; least number of days on which rain fell, 6, at Newcomerstown; greatest rainfall, 6.73 inches, at Youngstown; least rainfall, 2.17 inches, at Pomeroy.

The following is an extract from the "Tennessee State Board of Health Bulletin" for November, 1886, prepared under the direction of J. D. Plunkett, M. D., President of the State Board of Health. The weather report is prepared by H. C. Bate, Director of the State Meteorological Service:

There were no very striking features in the weather during the month of November, except the rain storms of the 17th and 21st. Except in the item of precipitation, the conditions showed but little departure from the normal.

The mean temperature was 46°.2, which was slightly below the mean of the month for the past four years. The highest temperature, 80°, was recorded on the 2d, and was 2° below the maximum of the month for 1883 and 1885, and 4° above the maximum of the month for 1884. The lowest temperature, 12°, was recorded on the 14th, and was 2° above the minimum of the month for 1883, and respectively 5° and 6° below the minimum for 1884 and 1885.

The mean depth of rainfall for the month was 6.39 inches, which was considerably above the mean for the month in the past four years, and above the normal. Of this amount the eastern division received an average of about 5.75 inches, the middle division an average of nearly 6 inches, and the western division an average of a little more than 7.50 inches. This was quite a difference in the rainfall in these two latter sections from that of the month previous, the average then being only about .50 inch. The greatest rainfall was 8.89 inches, reported at Memphis, and was the greatest November rainfall at that station during the past fifteen years, except in 1875, when the rainfall measured 9.63 inches. The rainfall at Nashville and Knoxville for the month was also above the normal, the latter being the greatest reported for November during the past fifteen years. This was doubtless the case at many stations throughout the state. The greatest local daily rainfall was 3.96 inches, reported at Covington on the 21st, on which date quite a number of stations reported heavy rains. On the 17th also there were heavy rains reported.

Summary.

Mean temperature, 46°.2; highest temperature, 80°, on the 2d, at Dyersburg and Woodstock; lowest temperature, 12°, on the 14th, at Farmingdale; range of temperature, 68°; mean monthly range of temperature, 51°.1; greatest monthly range of temperature, 60°, at Riddleton; least monthly range of temperature, 44°, at Careyville, Bolivar, and Covington; mean daily range of temperature, 18°.9; greatest daily range of temperature, 48°, on the 1st, at Hohenwald; least daily range of temperature, 1°, on the 21st, at Trenton, and on the 30th, at Riddleton; mean of maximum temperatures, 73°.3; mean of minimum temperatures, 22°.2.

Average number of clear days, 11.2; average number of fair days, 7.7; average number of cloudy days, 11.1; average number of days on which rain or snow fell, 10.

Mean depth of rainfall, 6.39 inches; mean daily rainfall, 0.21 inches; greatest rainfall, 8.89 inches, at Memphis; least rainfall, 3.77 inches, at Waynesborough; greatest local daily rainfall, 3.96 inches, on the 21st, at Covington; days of greatest rainfall, 12th, 17th, 21st, 22d, 23d; day of greatest rainfall, 17th; days without rainfall, 14th, 19th, 28th; mean depth of snowfall, 0.03 inch.

Warmest days, 1st, 2d; coldest days, 8th, 14th.

THE EFFECT OF WIND AND EXPOSURE UPON BAROMETRIC READINGS.

The following paper was read at the recent Buffalo meeting of the American Association for the Advancement of Science by Prof. Cleveland Abbe, Assistant:

The influence of the wind on the barometer, which has been recently discussed in "Science," is a matter that has engaged the attention of several meteorologists, each apparently ignorant of what others have done in the same direction. My own attention was first called to this matter by the daily use of Robinson's and Lind's anemometers at Cincinnati in 1869, and again by phenomena attending a severe wind in Washington in 1875, after which I wrote to Prof. A. H. Mayer, of Stevens' Institute, who noticed similar phenomena. But it was not until I read, in 1877, the first paper by Hagemann on his new form of anemometer, that a suggestion arose as to the possibility of measuring and eliminating this effect. This method I have explained in two lectures on anemometry delivered in February, 1882, an abstract of which is given on page 96 of the Annual Report of the Chief Signal Officer for 1882.

The portable Lind anemometer is essentially composed of a Pitot tube in front, joined with a Hagemann anemometer or a Magius tube in the rear. These two separate instruments when thus united record only differences of pressure by measuring the height of a small column of water in the siphon tube that joins them. If now for the column of water and siphon tube, we substitute two aneroid barometers, one at the bottom of each of the vertical tubes which are now supposed to be closed below, we then have from the reading of the barometer at the bottom of the Pitot tube, whose opening faces the wind, the static barometric pressure in the free air plus the mechanical pressure caused by the wind; while from the aneroid at the bottom of the Magius tube we get the difference between the barometric pressure and the mechanical effect of the wind on the opening of that tube.

Until this or some equivalent device is made use of by meteorologists, our barometric observations must continue to be affected by a source of error that Col. Henry James has shown may be at times of more importance than any of those at present recognized.

It is only within a few days that I have seen Colonel James' memoir in the Edinburgh transactions for 1862 and, as the volume is rare, the accompanying abstract may be acceptable; I also add an abstract of a short paper by the Hon. Ralph Abercromby, published in 1875.

The problem of the meteorologist is, how to determine the elastic or static pressure existing within a mass of moving air by means of a stationary barometer. In general the pressure recorded by our mercurial barometers is affected by the wind and depends upon the following considerations:

(1.) A wind blowing across the cistern or the open leg of the siphon of a barometer out of doors, or past the open window or chimney top of the observing room, will diminish the pressure.

(2.) The aspect of the observing room and the location of the window or other aperture, such as the chimney flue, the doors, etc., the location of the window with reference to the centre or edge of the windward or leeward side of a large building, may cause either an increase or diminution of pressure.

On the leeward side of a building the relief of pressure during high winds is known to be very considerable at times. I have known of a case in Washington City where the window of a closed hall room was burst outward by the expansion of the enclosed air when a gale swept by; undoubtedly a similar relief exists on the leeward side of mountain tops. The distribution of the differences of pressure between the front and rear of thin, square, plane plates has been studied by Messrs Curtis and Burton ("Quarterly Journal of the Meteorological Society of London," vol. VIII, 1882, p. 139), whose results give us some idea of what might take place in large buildings. The diminished pressure within a closed cylinder when a current of air blows across its mouth or when it blows longitudinally past its mouth, the diminished pressure on a leeward side of a building, and that in the rear of a rapidly moving ball, are all examples of similar problems in the flow of gases past obstacles. In the case of a cannon ball the space close behind it is nearly a vacuum.

Beginning with Halley the idea has frequently been suggested that horizontal winds tend to relieve the objects beneath them from the vertical air pressure, and in this way he explains the low pressure during high hurricane winds. The only sense in which this explanation is correct is that such horizontal winds have a slight centrifugal force with respect to the earth's center and must, therefore, tend to counteract gravity, but only by an inappreciable amount. Experience shows that we can have high winds and high barometer at the same time. The low pressures ordinarily experienced, so far as they are due to the wind, are explained by the two principles that meteorology owes to Ferrel, namely the horizontal deflections due to the rotation of the earth and the circulation around a storm-centre.

Abstract of the memoir "On a necessary correction to the observed height of the barometer depending upon the force of the wind," by Capt. Henry James, read 15th of March, 1852, from the Transactions of the Royal Society of Edinburgh, vol. XX, p. 377.

Abstract.

Capt. Henry James (afterwards Col. Sir Henry James) calls attention to the common observation of the oscillations of the mercury of the barometer during gales, and quotes the following extract from a letter received from Professor Airy: "I think, but am not certain, that the depression of the barometer at every gust of a gale of wind is an ordinary phenomenon without reference to the position of the barometer with regard to the direction of the wind. Many years ago I was in the observatory of Marseilles during the blowing of the 'Mistral,' a wind well known there, and there I saw the drop of the barometer at every gust in great perfection; I do not remember the position of the barometer." Colonel James was led to the investigation of this subject by a similar observation of a gale of wind, with the addition that the amount of the depression was in some proportion to the velocity of the wind. His isolated cottage was well situated for this investigation, and a succession of southwest gales afforded the opportunity for following up the inquiry and ascertaining the depression of the barometer corresponding to the different amounts of the pressure of the wind.

The barometer was an aneroid; the wind-gauge was a pressure anemometer of simple construction, the pressure being indicated by the compression of a spiral spring in a tube. When the wind blew with any considerable force it was found that the barometers in two sheltered positions, namely, in a cottage and in a summer house, were depressed as compared with the indications of the instrument on the open ground, and that in the two sheltered positions the depressions were in proportion to the force of the wind, and further, that every gust of wind was indicated by a corresponding depression of the barometer, while the barometer on the open ground remained stationary during all the changes in the amount of pressure of the wind, whether arising from the increased force of the gale or from the intermittent gusts.

It was therefore obvious that the cause of the depressions of the barometer was owing solely to the screened position of the instrument in the cottage and in the summer house, and that all barometers in detached houses or observatories in exposed situations must be similarly affected.

The cause of this phenomenon may be explained, he says, by the pneumatic experiments made by Hawksbee and Leslie, and by the hydrodynamic experiments of Bernoulli and Venturi.

If a window or door exposed to the wind is opened in any room in which there is a barometer, the mercury is raised, showing that the air is compressed in the room, as it is in Leslie's cylinder when we blow through the larger tube. So also the barometer is elevated by the compression of the air on the windward side of the summer house, whilst it is depressed on the leeward in proportion to the force of the wind and the intermittent gusts; but the effect in a room, the doors and windows of which are usually closed on the windward side, is to produce a depression.

"We may also infer, but I know of no experiments to support the opinion, that during gales of wind the barometer would stand at a higher level on the windward side of a hill than on the leeward, the points of observation being at the same altitude. The known discrepancies between the heights deduced from the indications of the barometer during high winds and calms are, however, most probably due to this cause."

The following table gives the depression of the barometer observed by Colonel James, with different wind-velocities. Unfortunately he makes no mention of the wind-directions and the corresponding exposure of the barometer during the observations:

Velocity in miles per hour.	Pressure in pounds per square foot.	Depression of the barometer in inches.
14.2	1	0.010
20	2	0.015
24.5	3	0.020
28.3	4	0.025
31.6	5	0.030
34.6	6	0.035
37.4	7	0.040
40.0	8	0.045

On certain small oscillations of the barometer, by Hon. Ralph Abercromby, Quarterly Journal, Meteorological Society, vol. 2, 1874–'5, p. 435.

Abstract.

Certain small oscillations in the height of the mercury in the barometer, sometimes called pumping, have been known to be associated with gusts of wind, but the precise nature of their action does not seem to be determined. In this country the oscillations rarely exceed 0.02 inch. In studying them I have found the aneroid preferable to the mercurial, owing to the absence of inertia.

The two following examples may be considered typical:

1873, Southend.—Window looking south; wind nearly south, in strong gusts. In this case the first motion of the barometer was always upwards about 0.01 inch, as if the effect of the wind, being arrested by the house, was to compress the air in the room.

1874, Brighton.—A corner house one window facing south, another facing west; wind south, strong gusts. With the west window open there was violent pumping, but in this case, the first motion was always downwards. On opening the south window as well, the pumping ceased.

RAINFALL AND ITS SOURCE IN THE SOUTHERN SLOPE.

[By Private I. M. CLINE, Signal Corps, U. S. A., Observer at Abilene, Texas.]

With the assistance of a series of observations taken under the auspices of the United States Signal Service, in that part of the southern slope which includes San Angelo and Abilene, Texas, extending through a period of ten years, I will give some deductions and advance a few views in regard to the rainfall in that section; noticing its distribution during the different months of the year and the direction of winds which favor the greatest abundance of rainfall.

It is an unquestionable fact that the annual amount of rainfall near the thirty-second parallel, after we cross the ninety-seventh meridian, decreases as we go westward, and after we cross the one hundred and second meridian the decrease is very marked and can readily be seen from casual as well as actual observation; and as we near the Rocky Mountains the precipitation is very small. The section of country of which I speak is as far west as 99° 45′ west longitude, and at an elevation of from 1,700 to 1,900 feet above the sea-level; yet I am of the opinion that the rainfall of this section is sufficient for all agricultural purposes.

From a period of years we make the following deductions, giving the average rainfall in inches, tenths, and hundredths during the time named, for each month of the year: average for nine years, January, 1.02 inches; February, 1.07 inches; March, 1.46 inches; average for ten years, April, 2.16 inches; May, 3.74 inches; June, 2.79 inches; July, 3.26 inches; August, 3.40 inches; September, 4.16 inches; October, 2.94 inches; November, 1.12 inches; average for nine years, December, 2.08 inches; average annual rainfall for nine years and eight months, 29.20 inches.

From the above it is readily seen that the rainfall is over three times as much during the spring and summer months as it is during the winter months, the principal amount falling during the spring and summer, the time at which it is most needed for agricultural purposes; and in my opinion, while it is not so much rain as some eastern states have, or even the eastern part of this state, it is sufficient in quantity for any products which are adapted to this latitude, from the fact that the soil here retains moisture three times as long as the soil of states where rain is more abundant.

Out of a period extending through one hundred and sixteen months we find the prevailing direction of wind from a southerly and southeasterly quarter for seventy-six months, nearly twice as many as from all other six points of the compass together. This, in my opinion, is due to the fact that being north of the southern limit of the winds of the middle latitudes, the surface winds, on account of the rapid increase in altitude and the topography of the country, are deflected to the west; hence we get southerly and southeasterly winds instead of southwesterly winds, and it is to these southeasterly winds we are dependent for our rainfall; for, as I shall endeavor to show, the greater part of, if not all, of the moisture which reaches this section of country, is either brought from the equatorial regions or the Gulf of Mexico; the principal amount, in my opinion, reaches us from the former named source in this way: the moisture is carried up near the equator where the surface winds of the equatorial system rise to make their return through the upper strata of atmosphere, then coming down near the thirty-second parallel, still retaining in suspension a considerable amount of the moisture taken up at the equator; and this moisture is carried northward by the winds of the middle latitudes and reaches this section by means of the southerly and southeasterly winds which prevail. The moisture received from the Gulf of Mexico reaches this section by means of southeasterly winds produced by local and general atmospheric conditions different from the causes which produce the general systems of wind.

My reasons for giving the preceding as the sources of rain for this section are based on the fact that no moisture can reach this place from the Pacific Ocean, because the Rocky Mountains lie between us and that body of water, and their elevation is such that all moisture coming from that quarter is precipitated on the west side of that range of mountains, because the air in crossing them is carried to such an elevation that by expansion it is cooled down to the temperature of the dew-point, and, consequently, deposits all its moisture before it reaches the eastern side of the mountains. This is the cause of the westerly and northerly winds throughout this section being so dry; they have, in crossing the mountains referred to, been robbed of all their moisture.

It has been decided that the maximum rainfall varies in elevation depending on local influences, between an elevation of 1,900 and 5,000 feet above sea-level. Now this section is near the former elevation, with local influences which favor a good average rainfall. We have already noted the fact that the prevailing winds of this section are from a southerly and southeasterly quarter and are laden with moisture from the equatorial regions and the Gulf of Mexico, and in coming to this section they pass over sections of country of less altitude than this, and, consequently, there is nothing to deprive them of their moisture and they reach here with a sufficient quantity.

The same atmospherical conditions favor the precipitation of moisture here that they do elsewhere, and the topography of the country is very favorable, for on the western border of this section the increase in elevation is very rapid, soon reaching an altitude of between 3,000 and 4,000 feet above sea-level, which causes the moist atmosphere to be thrown up to an elevation over this section of country that will reduce it to the temperature of the dew-point, and, consequently, precipitate its moisture in some form. By the time the air comes in a few hundred miles of the Rocky Mountains it is deprived of all its moisture and goes on dry; this, in connection with the westerly and northerly winds being deprived of their moisture in coming over the mountains, causes the barren plains on the eastern Rocky Mountain slope.

[The observations, upon which the preceding is principally based, were taken at Concho, Texas, from April, 1877, until December, 1885; since that time at Abilene, Texas.]

The following article, by Dr. H. B. Baker, Secretary of the Michigan State Board of Health, is from the "State Republican," of September 3, 1886, published in Lansing:

CAUSE OF PNEUMONIA.

Secretary Baker, of the State Board of Health, has devoted most of the leisure time at his disposal for months to a determined effort to trace out the cause of pneumonia, which is so prevalent in Michigan during the colder months. He has prepared diagrams and statistics based upon over 27,000 weekly reports of sickness in the state, and upon over 120,000 meteorological observations, and the conclusions arrived at point so uniformly in the same direction that Dr. Baker is confident that complete success has crowned his efforts.

"My statistics," he said to-day, "demonstrate, I think, that the sickness from pneumonia is absolutely controlled by the temperature of the atmosphere. The higher the temperature the less sickness from pneumonia, and the lower the temperature the more sickness. The fact which I think I have completely demonstrated is that in any given place, wherever studied, pneumonia is quantitatively proportionate to the coldness and dryness of the atmosphere, and it follows that if there is any pneumonia which is infectious, it is absolutely dependent upon these meteorological conditions for its action upon the human organism.

"Boiled down, my theory is as follows: Air expired from the human lungs is nearly saturated with vapor of water at a temperature of about 98°, and this contains about 18.69 grains of vapor in each cubic foot. The quantity of vapor exhaled is at all times greater than the quantity inhaled, but when the air is very cold and dry the quantity exhaled is excessive, as may be seen when we reflect that the air at 32° can contain in each cubic foot only about two grains of vapor. The fluid which passes out from the blood into the air-cells of the lungs, and which nominally keeps them moist, contains some of the salts of the blood; and the chloride of sodium not being volatile, is mostly left in the air-cells when the vapor passes out with the expired air. When the air inhaled is excessively dry, as it always is when excessively cold, this salt collects in the air-cells of the lungs in considerable proportion.

"This is proved by my statistics, which show the increase of pneumonia at such times, taken in connection with the fact that chloride of sodium in the lungs is in excess in pneumonia, which was proved in 1851 by Lionel S. Beale, M. D., of London, England. In the air cells the chlorides are irritating when they become concentrated; but the exudation of fibrine, which is the most prominent condition in pneumonia, is probably favored by a fact in osmosis which is not generally well understood, namely, that albumen, which it is usually considered will not pass by osmosis, will pass through an animal membrane to a solution of chloride of sodium. Thus the causation of pneumonia by the inhalation of cold, dry air seems to be completely worked out. It is hoped that its prevention may now begin."